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RESEARCH ARTICLE

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Global and Regional IUCN Red List Assessments: 15

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Abstract

In this contribution, the conservation status assessment of three vascular plants are presented according to IUCN categories and criteria. It includes the assessment of *Oryza rhizomatis* D.A.Vaughan and *Saxifraga facchinii* W.D.J.Koch at a global level and *Helianthemum caput-felis* Boiss. at a regional level.

Keywords

conservation, extinction risk, IUCN protocol, threats

How to contribute

The text of the global and regional assessments should be submitted electronically to Simone Orsenigo (simone.orsenigo@unipv.it) or to Giuseppe Fenu (gfenu@unica.it); the text, up to 8000 characters in length (spaces included), must include a distribution map and a picture of the assessed species.

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Red List Assessments

Oryza rhizomatis D.A.Vaughan

Global assessment
Taxonomy and nomenclature
Order: Poales *Family*: Poaceae

Oryza rhizomatis D.A.Vaughan, Bot. J. Linn. Soc. 103(2): 160 (1990)

Common name: Uru wee (Singhalese), rhizomatous rice (En).

Geographic distribution range: *Oryza rhizomatis* (Fig. 1) is endemic to Sri Lanka (Vaughan 1990) and it is restricted to the low altitude dry zone of eastern and south-western Sri Lanka (Liyanage et al. 2002). *Oryza rhizomatis* occurs only in six administrative districts: Puttalam, Anuradhapura, Kurunagale, Hambantota, Monaragale and Ampara (Fig. 2).

Distribution: *Countries of occurrence*: Sri Lanka.

Biology: *Plant growth form*: Perennial (hemicryptophyte).

Flowering and fruiting time: The flowering season is from late September to May, with a peak from January to April. Mature panicles have been observed from January to March. However, most of the seeds are dispersed from panicles after March (Liyanage et al. 2002; field observations of authors).

Reproduction: Reproduction occurs by seeds. Seeds of *O. rhizomatis* are capable of dormancy (Timple et al. 2018), but no detailed information on seed germination is available. Underground rhizomes contribute to reproduction through vegetative means.

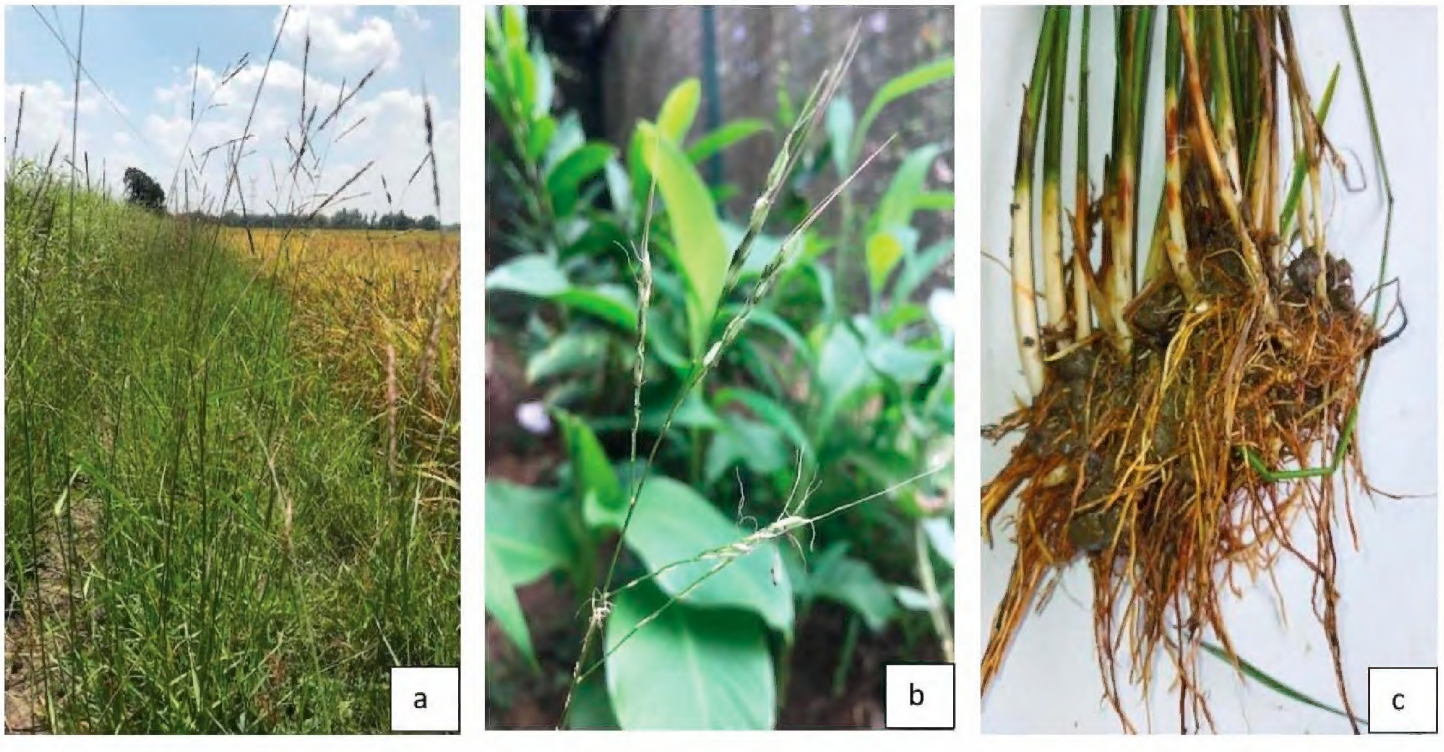

Figure 1. Natural habitat (**a**) panicle (**b**) and rhizome (**c**) of *Oryza rhizomatis* located at Karuwalagaswewa, Sri Lanka (photograph by Thasajini Sajeevan).

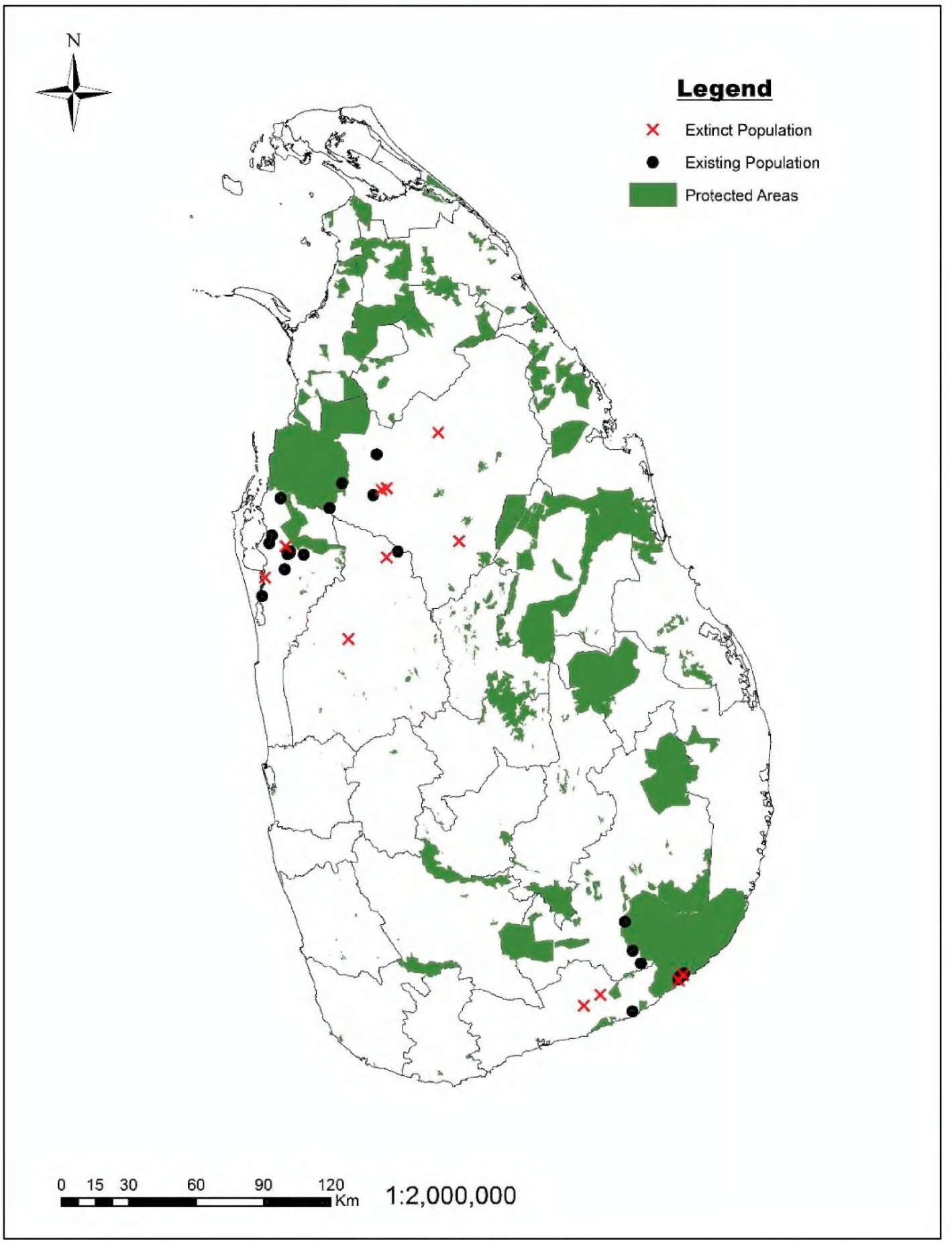

Figure 2. Distribution map of *Oryza rhizomatis* in Sri Lanka showing current (black dot) or extinct (red cross) populations according to recent field surveys.

Habitat and ecology: Field records suggest that *O. rhizomatis* occurs in forests and open, tall scrub with grassy clearings. It occurs in swampy or periodically flooded areas, usually in full sun or partial shade. The dry zone of Sri Lanka where *O. rhizomatis* grows is characterized by an annual rainfall of 850–1900 mm (Vaughan et al. 2003).

Population information: There is no detailed information available on population dynamics. However, field observations show that the habitats of *O. rhizomatis* are becoming degraded due to urbanization and grazing by animals in most localities. Several populations in the districts of Puttalam, Kurunagale, Anuradhapura and Hambantota reported earlier (Liyanage et al. 2002; Ratnayake et al. 2021), could not be found during recent field surveys in 2021 and 2022. This suggests that the number of mature individuals in many populations and, therefore, overall population size may be declining.

Threats: *1.1 Residential and commercial development (Housing and urban areas)*: some populations in the Northwestern province are threatened by urbanization, especially construction of houses and roads.

2.3.1 Livestock farming and ranching (Nomadic grazing): in many sites, populations of *O. rhizomatis* are impacted by grazing of domestic animals, such as cattle and goats. Further, elephant grazing was observed in some populations situated within forests or close to forests.

4.1 Transportation & Service corridors (Roads & Railroads): populations reported in the Northwestern province of Sri Lanka (Liyanage et al. 2002) grow along the roadside. Furthermore, development of roads and roadside cleaning could disturb the natural vegetation.

9.3.3 Agricultural & forestry effluents (Herbicides & Pesticides): three populations in Puttalam district and one locality in Anuradhapura district are near cultivated fields; they could be affected by hazardous herbicides and pesticides, and further expansion of agricultural lands.

10.2 Geological events (Tsunami): The coastal populations in Hambantota district, especially in Kirinda, were affected by widespread destruction around the coastal belts of the country due to the tsunami waves in 2004. A widespread population decline, down to 20 individuals, was caused by this disastrous event.

11.2 Drought: The conservation of *O. rhizomatis* depends on the presence of swampy or periodically flooded areas, therefore drying up of swamps during the wet season due to high temperature and reduced precipitation could affect populations of this species.

CRITERIA APPLIED

Criterion A: There has been a decline in AOO (37%) and EOO (28%) in the last 20 years with destruction and loss of habitat quality. Twelve populations were not confirmed during the field surveys conducted from 2020 to 2022.

(c) A decline in habitat quality, AOO and EOO by 36.66 and 27.75%, respectively was observed.

Criterion B: **EOO:** 14,603 km^2 calculated with GeoCAT (Geospatial Conservation Assessment Tool) software (Bachman et al. 2011).

AOO: 76 km^2 calculated with a 2×2 km cell fixed grid

a) No severe fragmentation and number of locations >10
b) Continuing decline observed in EOO, AOO, extent and quality of habitat, and number of mature individuals.
c) No extreme fluctuations.

Red list category and Criterion

VU	**Vulnerable**	**A2c**

Rationale for the assessment: *Oryza rhizomatis* is endemic to Sri Lanka**.** Recent field surveys have demonstrated that there has been a continuous decrease in population size, which currently continues, a reduction of AOO, and EOO and a loss of suitable habitats. The EOO has declined from 20,213 to 14,603 km^2 (28%). The AOO has decreased from 120 to 76 km^2 (37%) in the last 20 years. Populations are threatened by urban, residential, and industrial developments, roads and agriculture, as well as by grazing domestic and wild animals. The AOO is less than 500 km^2 and it almost qualifies for a threatened listing under criterion B1, no severe fragmentation or extreme fluctuations is observed, and the number of locations is higher than 10. For this reason, this plant is considered as Vulnerable (VU) under criterion A2c at a global level.

Previous assessment: *Oryza rhizomatis* was assessed at global level as Near Threatened (NT) with an urgent need for information on its population trends (Phillips and Yang 2017). According to the national Red List of Sri Lanka (The National Red List 2020) it was categorized as Vulnerable (VU).

Conservation actions: There are 20 *ex situ* accessions stored in the germplasm bank of the International Rice Research Institute and 23 accessions are present in the Plant Genetic Resources Center, Peradeniya, Sri Lanka. The species is present within protected areas of Sri Lanka including the Yala National Park, Luhugala National Park and Wilpattu National Park. The first *in situ* conservation site for wild rice in Vanathavilluwa (Puttalam district) was established under the Northwestern Province Environmental Statute No: 12 of 1990.

Conservation actions needed: Research and monitoring activities are needed to better understand the population trend of this species. Moreover, to implement genetic variability of *ex situ* accessions, new seed collections should be planned.

Notes: *Oryza rhizomatis* is related to other species of the *O. officinalis* Wall. ex Watt complex but differs from it in having a different spikelet and panicle structure. It differs morphologically from *O. eichingeri* Peter (of which it is considered a synonym by some authors, Clayton et al. 2006) and the tetraploid *O. minuta* J.Presl by its larger plant and spikelet size, larger panicle with widely spreading branches, and rhizomes.

Thasajini Sajeevan, Malaka Wijayasinghe, Andrea Mondoni

Saxifraga facchinii W.D.J.Koch

Global assessment
Taxonomy and nomenclature
Order: Saxifragales *Family*: Saxifragaceae

Saxifraga facchinii W.D.J.Koch Flora 25(2): 624 (1842); Syn. Fl. Germ. ed. 2, 445

Common name: Sassifraga di Facchinii (It).

Geographic distribution range: *Saxifraga facchinii* (Fig. 3) is a rare perennial hemicryptophyte that occurs only in the Dolomites (Italy), on several massifs (Catinaccio/Rosengarten, Pale di San Martino, Marmolada, Sella, Sasso Lungo/Langkofel group, Tofane, Conturines, Odle), on calcareous and dolomitic rocks. More than half of the occupied habitat area is in small and isolated patches, thus definitely fulfilling the criteria for considering the species as "severely fragmented" (Fig. 4).

Distribution: *Countries of occurrence*: Italy.

Biology: *Plant growth form*: Perennial (hemicryptophyte).

Flowering time: From late July to September.

Reproduction: The most probable dispersal strategy is barichory (autochory). No information on pollination and seed germination is available.

Figure 3. *Saxifraga facchinii* at Piz Lavarella (Badia, Bozen, Italy), 2850 m a.s.l. (Photograph by Francesco Rota).

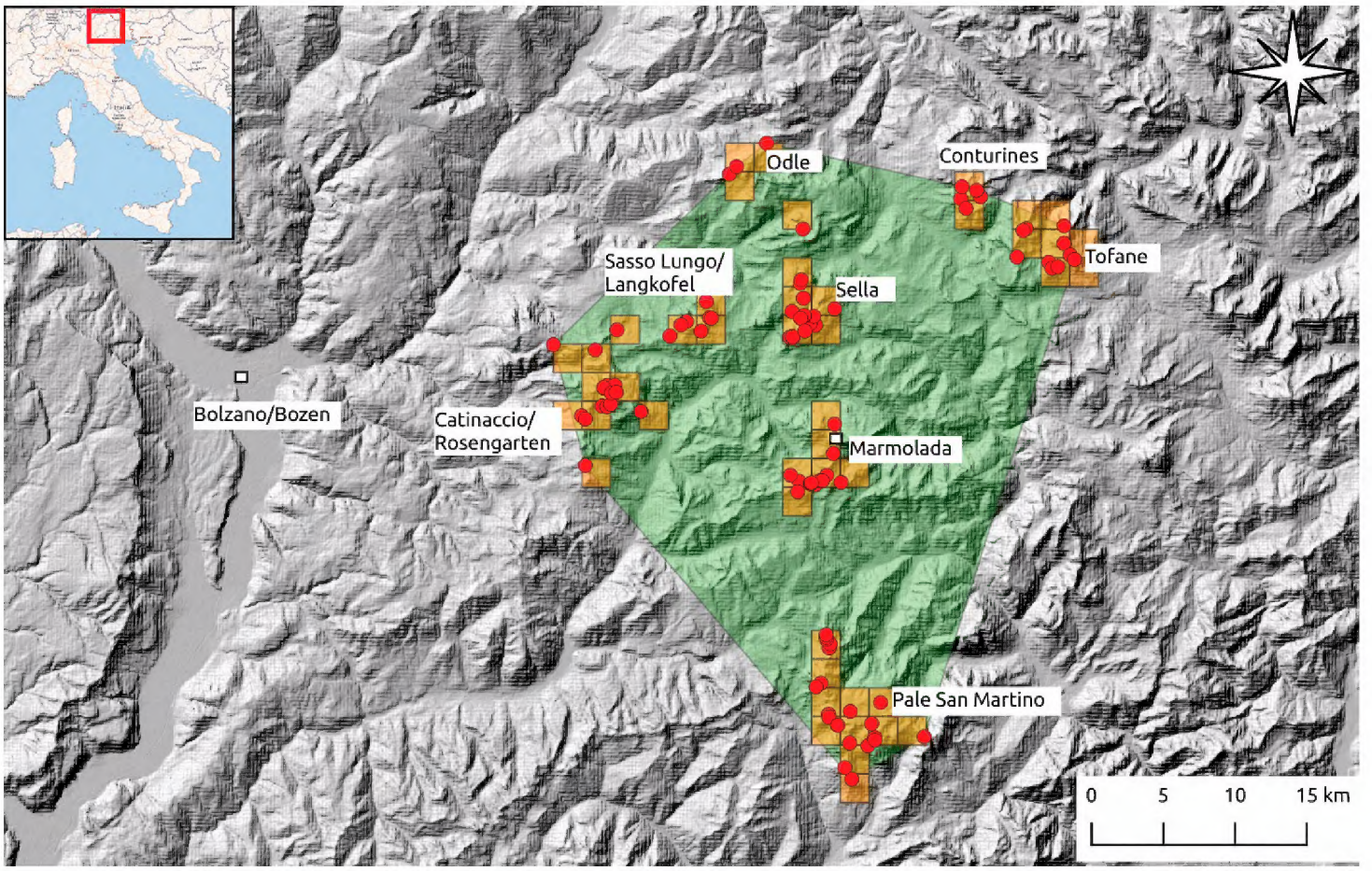

Figure 4. Hillshade map of the Dolomites with the occurrences of *Saxifraga facchinii* showing the EOO (in green), and AOO (in orange) grids (2×2 km) where the species occurs.

Habitat and ecology: *Saxifraga facchinii* grows on carbonate (dolomitic and calcareous) rocks at an elevation of about 2600–3200 m a.s.l., on ridges, crests and rocky habitats. It belongs to high-alpine to nival hemicryptophytic plant communities characterized by the occurrence of some endemic taxa, such as *Draba dolomitica* Buttler.

Population information: There is no detailed information available on population dynamics. Field observations indicate some stable subpopulations (Pale di San Martino/Sella), while all the others show only few scattered individuals. Subpopulations that were recorded at the beginning of the 20th century near the lower elevational limit of the distribution of the species (2500 m) in the Schlern/Sciliar massif (that has a maximum elevation of 2563 m) (see www.florafauna.it), are now missing (personal field observation). They are very likely extinct, since the occurrence areas reported one century ago, have now become arid meadows on calcareous shallow soil with *Sesleria caerulea* (L.) Ard., and the rocky habitats typical of the species have already shrunk, filled by expanding low alpine communities.

Threats: *1.3. Tourism and recreational areas*: some subpopulations could be threatened by projects aimed at developing and connecting skiing areas at high elevations.

5.2.1. Gathering terrestrial plants, intentional use: the plant might be collected by amateurs and rock garden species collectors.

6.1. Recreational activities: some populations have individuals that grow on trails used by hikers and climbers and are, therefore, threatened by human trampling.

11.1. Habitat shifting & alteration: the plant is potentially threatened by natural habitat evolution (growth of grass and shrubs on partially stabilized debris); this process is particularly evident at the lower climatic boundary of the species around 2600 m.

CRITERIA APPLIED

Criterion B: **EOO**: 978 km^2 calculated with QGIS 3.0 software with minimum convex hull

AOO: 196 km^2 calculated with a 2×2 km cell fixed grid

a) Severely fragmented.
b) Continuing decline projected in: (iii) area extent and quality of habitat (Rota et al. 2022), (iv) number of subpopulations or location.

Red List category and Criteria (Global Assessment)

EN	**Endangered**	**B1ab(iii,iv)+B2ab(iii,iv)**

Rationale for the assessment: *Saxifraga facchinii* is a rare plant endemic to the highest peaks of the Dolomites currently occurring only in the Pale di San Martino, Marmolada, Catinaccio/Rosengarten, Sella, Sasso Lungo/Langkoffel, Tofane, Conturines and Odle groups; some populations consist of a relatively higher number of mature plants (Pale di San Martino, Sella), while the northern edge populations are very rare, scattered and with few individuals only (personal observation). *Saxifraga facchinii* could be affected in the near future by the effects of the ongoing climate change with a habitat loss, projected to 2070, in the rcp 4.5 scenario of an average –75.52% (± 19.86) and in the rcp 8.5 scenario of an average –87.59% (± 20.06) (Rota et al. 2022). Taking together the previous assessments and the newly gathered data by Rota et al. (2022), this species is upgraded to Endangered (EN) at a global level.

Previous assessment: The taxon was evaluated as NT at the global level in the Red List of Endemic Plants of Italy (Rossi et al. 2020). At a regional level, it was evaluated as EN for the Veneto administrative region (Buffa et al. 2016), VU for the Autonomous Province of Bozen/Bolzano (Wilhalm and Hilpold 2006) and NT for the Autonomous Province of Trento (Prosser et al. 2019).

Conservation actions: *Saxifraga facchinii* is not protected either by international, national or regional laws. At present, there are no conservation measures for this species. Many populations grow in protected areas, within the Natural Parks of Paneveggio-Pale di San Martino Natural Park, Puez Odle, Sciliar-Catinaccio, Fanes Sennes Braies, and Dolomiti d'Ampezzo, while others grow in areas with high rates of human disturbance due to alpine tourism (Sella and Marmolada).

Conservation actions needed: Research activities and a monitoring program are recommended in order to better understand the reproductive biology of the species and the population trend. Moreover, *in situ* and *ex situ* conservation actions should be designed for possible population reinforcement plans and assisted colonizations, aimed at increasing the probability of survival under climate change.

A specific monitoring program would be important to prevent and evaluate the possible future threats (e.g., increasing temperature, increasing human activities such

as expansion of ski resorts at high elevations, or stochastic events), which could change the current conservation status of this plant.

Notes: The present assessment is based on the PhD thesis of F. Rota, funded by the Free-University of Bozen-Bolzano. The idea originated at the COST Action 18201 "Conserve Plants" during the training school on IUCN Red List assessment held in Podgorica (MNE) in spring 2022. We thank Gabriele Casazza (Università di Genova), Michele Da Pozzo (Parco Naturale delle Dolomiti d'Ampezzo), Thomas Wilhalm (Museo di Scienze Naturali dell'Alto Adige), Malin Rivers (Botanic Gardens Conservation International and IUCN/SSC Global Tree Specialist Group) and several participants of the COST training school for their contribution to the discussion on this assessment.

Francesco Rota, Juri Nascimbene, Camilla Wellstein

Helianthemum caput-felis Boiss.

Regional assessment (Italy)
Taxonomy and nomenclature
Order: Malvales *Family*: Cistaceae

Helianthemum caput-felis Boiss. Elench. Pl. Nov.: 16 (1838).

Common name: Rock rose (En), Eliantemo a testa di micio (It), Jarilla de cabeza de gato (Es).

Geographic distribution range: *Helianthemum caput-felis* (Fig. 5), which ranges in height from 35 to 50 cm, is a thermophilous long-lived shrub distributed in several disjunct and fragmented populations throughout the coasts of the western Mediterranean Basin (SE Iberian Peninsula, Balearic Islands, Sardinia, and NW Africa; Sulis et al. 2020). In Sardinia, two main populations are present, but isolated or scattered groups of plants are also present outside these populations, all located in the Sinis Peninsula (Fig. 6).

Distribution: *Countries of occurrence*: Algeria, Italy (Sardinia), Morocco, Spain.

Biology: *Plant growth form*: Half shrub (chamaephyte).

Flowering and fruiting time: The phenological period varies according to the locality; in Sardinia, the flowering period is from March to June, and the fruiting season runs from late April to the beginning of August (Fenu et al. 2015; Sulis et al. 2017). Flowers of *H. caput-felis* are hermaphrodite and have a short lifespan (3–4 days; Rodríguez-Pérez 2005).

Reproduction: It is an entomophilous, mostly self-incompatible, plant species; fruits are capsules that detach at maturation, and seed germination takes place in autumn, at the onset of the rainy season (Rodríguez-Pérez 2005). Seeds exhibit a high germination rate after scarification (Rodríguez-Pérez 2005; Sulis et al. 2017).

Habitat and ecology: *Helianthemum caput-felis* is a thermophilous long-lived half shrub with a growth preference for coastal areas under the direct influence of the sea,

Figure 5. *Helianthemum caput-felis* Boiss. at Capo Mannu (San Vero Milis, Oristano, Sardinia, Italy). (Photograph by Giulia Calderisi).

mostly on calcareous rocky cliffs (0–200 m a.s.l.) with garrigues or scrublands; some populations grow sand dunes in Majorca, fossil dunes in Morocco and rocky slopes bordering inland ravines and, rarely, in open wooded areas (Fenu et al. 2015; Sulis et

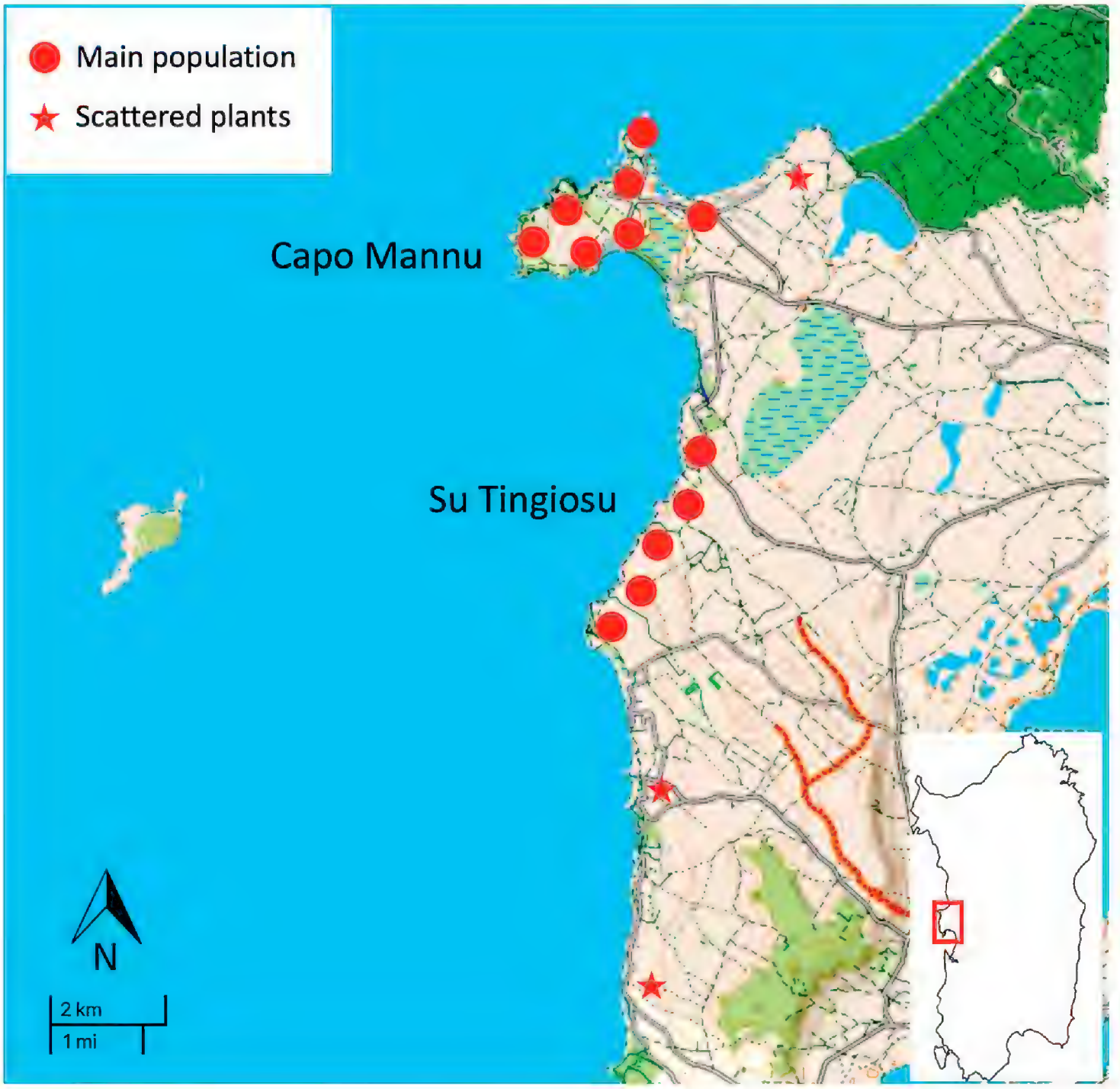

Figure 6. Geographic range and distribution map of *Helianthemum caput-felis* Boiss. in Sardinia (Italy).

al. 2020). In Sardinia, *H. caput-felis* grows on limestone or arenaceous substrates and, sometimes, sandy soils, at altitudes up to 55 m a.s.l.; sporadically, it can be found on evolved soils, in the clearings of the juniper scrublands. The species participates in and characterizes plant communities rich in endemics (*Limonium lausianum* Pignatti, *Polygala sinisica* Arrigoni) and other species of phytogeographic interest (*Viola arborescens* L., *Coris monspeliensis* L., *Erica multiflora* L.).

Population information: Numerous populations, representative of the range of the species, present in Spain and Sardinia are included in a recent study of population dynamics covering a four-year period (Sulis et al. 2018, 2021); the results of this short-term dynamic study indicate that the global *H. caput-felis* population was at equilibrium, although this result seems to disagree with the threats and the human disturbance observed in the field (Sulis et al. 2018). Sardinian populations are those that have greater equilibrium ($\lambda > 1$), probably due to the stable structure of the populations, which are mainly composed of large individuals (Sulis et al. 2021); specifically,

the population of Capo Mannu is in demographic growth, while that of Su Tingiosu is stable (Sulis et al. 2021). The monitoring activities show no signs of continuous decline, if some stochastic events (landslides) that have affected the Su Tingiosu population, and caused a reduction in the number of individuals, are excluded.

Threats: *6.1 Recreational activities*: the growing tourist development of the coasts and of the Capo Mannu area in particular, with the consequent modification of the territory, was considered the main threat to the species; in fact, in these territories there has been an increase in recreational activities, in particular hiking and extreme off-road competitions, which have caused a loss of individuals and a fragmentation of the habitat with the opening of new paths within the population (Fenu et al. 2015). However, the periodic monitoring activities do not detect a continuous decline in the populations.

2.2 Wood & pulp plantations and 2.3 Livestock farming & ranching: in the past, the areas of occurrence of the populations were regularly used for non-indigenous crops and grazing (mainly sheep in Su Tingiosu) and subjected to reforestation (Capo Mannu).

8 Invasive & other problematic species, genes & diseases: if not adequately controlled, the presence of numerous alien species, widely used in tourist villages and in some cultivations, could constitute a potential threat to the species.

10.3 Avalanches/landslides: stochastic events, such as the natural evolution of the rocky cliffs affected in recent decades by landslides and collapses, especially in the Su Tingiosu population, have led to the loss of individuals.

CRITERIA APPLIED

Criterion B: **EOO:** 16 km^2
AOO: 16 km^2 calculated with a 2×2 km cell fixed grid

a) The Sardinian populations are not fragmented.
b) No continuous decline observed in extent of occurrence, area of occupancy, extent and quality of habitat, number of locations and subpopulations, and number of mature individuals.

Red List category and Criteria (Regional Assessment)

NT	**Near Threatened**	

Rationale for the assessment: At a global level *Helianthemum caput-felis* has been categorized as EN under criterion E (Sulis et al. 2020). In Sardinia, although this plant is subjected to some natural and human-related factors, their populations are in expansion and a continuous decline has not been observed. Our results of the population dynamics study support the downgrading of the risk category previously assigned at the regional level. However, considering that the abovementioned threats, especially those related to the natural evolution of the cliffs, could increase in the near future,

and adopting a precautionary approach suggested by the IUCN guidelines, this species could be assessed as NT at the regional level, on the understanding that if the predicted threats affect populations, it would qualify to be classified as EN due to the low AOO, combined with declining habitat surface and number of mature individuals.

Previous assessment: The taxon is evaluated EN at the global level (Sulis et al. 2020). At a regional level, *H. caput-felis* was recorded as EN in Europe (Bilz et al. 2011) and Spain (Agulló et al. 2011), and Critically Endangered in Algeria (Agulló et al. 2017) and Italy (Fenu et al. 2012).

Conservation actions: *Helianthemum caput-felis* is included in Annex I of the Bern Convention (Convention on the Conservation of European Wildlife and Natural Habitats 1979, updated in 2002), and, at the European level, in Annex II of the Habitats Directive (92/43/EEC). All Sardinian populations are included in protected areas, such as Natura 2000 sites (ITB030038 – Stagno di Putzu Idu, Salina Manna e Pauli Marigosa and ITB030080 – Isola di Mal di Ventre e Catalano), the MPA "Penisola del Sinis – Isola di Mal di Ventre and the Regional Park of Montiferru-Sinis Peninsula (L.R. 31/89). The Sardinian populations are being monitored since more than 20 years. Seeds of this species are stored *ex situ* in various European germplasm banks.

Conservation actions needed: Continuous monitoring is required of all populations, which is essential for assessing the conservation status and identifying effective local conservation measures when necessary.

Note: *Helianthemum caput-felis* has been subjected to translocation actions in different parts of its distribution range with positive results (Fenu et al. 2023), therefore this *in situ* conservation action could be widely exploited in the case of local extirpations or to reinforce small existing populations.

Giulia Calderisi, Donatella Cogoni, Giuseppe Fenu

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